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AVAILABILITY OF FOODS CONTAINTING GENETICALLY MODIFIED ORGANISMS ON THE POLISH MARKET

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Abstract: The paper presents a list of genetically modified plants which can be used as ingredients of foods. According to the EU legislation, the following genetically modified organisms are admitted in food production: maize, rapeseed, soy, sugar beet and cotton. This is why the paper contains the analysis of the contents of foods available in Poland which can potentially contain these source materials. The research revealed that until 2009, foods with genetically modified organisms could be found on the market. The analysis of the labels on foods sold in two hypermarkets showed that none of the list of ingredients placed on the product labels contained information about the use of genetically modified source materials.

Key words: GMO, genetically modified food, soy products, GMO rapeseed, GMO maize

Introduction

Genetic modifications in plants are used all over the world mainly in order to give them specific favourable features enhancing the crops and improving their usability by increasing their immunity to pests, diseases and environmental stress. Despite numerous advantages, foods containing genetically modified ingredients raise many doubts, including those concerning their influence on human health. It needs to be emphasised that before being placed on the market, foods containing genetically modified ingredients undergo a series of procedures aiming to examine their safety to human health. In accordance with the relevant legislation, only those food products which have undergone all test successfully and have been considered safe can be placed on the market. Yet, humans' attitude towards GMO food is not positive.

The food market in Poland is rich and it could be a source of foods containing genetically modified organisms. Therefore, the aim of the paper was to analyse the products available on the market with reference to the contents of such components as ingredients of selected groups of foods.

GMO food legislation

According to the Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed, GMO foods include those containing, consisting of and produced from a GMO. According to the definition of the GMO provided in Article 3 of the Act of 22 June 2001 on genetically modified organisms, a GMO is an organism different from a human organism in which genetic material has been changed in a way that does not occur in the natural conditions by means of cross-breeding or natural recombination. A GMO is obtained in laboratory conditions with the use of genetic engineering, by genetic modification whose aim is to give new features to an organism by introducing to the receiver's genome a DNA fragment being a genetic combination conditioning acquisition of a concrete and specific new feature [1–3].

GM plants used in food production

The methods of obtaining genetically modified plants and the features which are modified are described in literature [3, 5].

GM plants used in food production include: rapeseed, maize, sweet corn, cotton, potatoes, rice, soy, sugar beet, tomatoes, papaya, egg plant, sweet peppers (the selected plants are presented in Table 1). According to the ISAAA (International Service for the Acquisition of Agri-Biotech Applications) in its report of 2013, 2014 and 2015 Global Status of Commercialized Biotech/GM Crops, the GMO cultivated land is increasing year by year or at least it stays at the comparable level. In 2013, it was 175.2 million hectares in 27 countries, in 2014 – 181.5 million hectares in

Table 1: Selected GM plants and their products authorised by the EU [4]

No	Modified plant	Modified feature	Usability
1	Cotton (GHB614) BCS-GHØØ2-5	Glufosinate herbicide tolerance.	Food and its ingredients containing, consisting of or produced from GHB614 cotton, including food additives.
2	Maize (Bt11) SYN-BT Ø11-1	Glufosinate herbicide tolerance and insect resistance.	Food and its ingredients containing, consisting of or produced from Bt11 maize.
3	Maize (MON810) MON-ØØ81Ø-6	Some *Lepidoptera* resistance.	Food and its ingredients produced from MON810 maize, including food additives.
4	Rapeseed (GT73) MON-ØØØ73-7	Glyphosate herbicide tolerance.	Food produced from GT73 rapeseed (refined oil and food additives).
5	Rapeseed (MS8, RF3, MS8xRF3) ACS-BNØØ5-8ACS-BNØØ3-6ACS-BNØØ5-8 x ACS-BN003-6	Glufosinate herbicide tolerance.	Food and its ingredients containing, consisting of or produced from rapeseed, including food additives.
6	Soy (A2704-12) ACS-GMØØ5-3	Glufosinate herbicide tolerance.	Food and its ingredients containing, consisting of or produced from A2704-12 soy, including food additives.
7	Sugar beet (H7-1) KM-ØØØ71-4	Glyphosate herbicide tolerance.	Food and its ingredients produced from H7-1 sugar beet.

28 countries and in 2015 – 179.7 million hectares also in 28 countries. The above-mentioned reports list the greatest GMO producers with the United States at the first position (70.1m ha in 2013 and 70.9m ha in 2015), Brasil (40.3m ha in 2013 and 44.2m ha in 2015), Argentina (24.4m ha in 2013 and 24.5m ha in 2015), India (11.0 and 11.6m ha in 2013 and 2015 respectively) and Canada (10.8 and 11 million ha in 2013 and 2015). The next places are occupied by China, Paraguay, Pakistan and South Africa with much smaller cultivation areas. The greatest area is taken by GM soy, followed by maize, cotton and rapeseed [6–8].

In Europe in 2013, there was only one genetically modified plant, i.e. MON810 maize grown in five countries: Spain, Portugal, the Czech Republic, Romania and Slovakia [6]. In this Report, Spain and Portugal had 100,000 ha (0.1m ha) each, and below 100,000 ha was located in the remaining three countries. In 2015, the GM maize cultivated area in Europe was the same: 200,000 ha in Spain and Portugal (100,000 ha each) and separately below 100,000 ha in the following countries: the Czech Republic, Slovakia and Romania [8].

According to the EU Register of GM Food and Feed available at the European Commission website, products containing, consisting of or produced from GM maize, cotton, rapeseed, soy and sugar beet can be placed on the EU market. Other GMOs are not admitted [9].

GM food safety

GM food raises a lot of controversy connected mainly with its safety. It is assumed that the main threats from GM food on human health are: its possible toxicity, capability of causing allergies, genetic changes and a possible transfer of resistance to antibiotics. The threats related to GM food consumption can be divided into three categories. The first one includes the effects of the gene inserted and its expression such as the synthesis of a new protein which can be allergenic. The second group covers mutageneses which can result in interruptions or alterations in gene expression of the genes in plants. The last category includes secondary and pleiotropic effects of gene expression, transgenes can code enzymes which can influence biochemic pathways, which can trigger changes in the concentration of biochemical compounds. The effect of such changes on metabolism could be an elevated concentration of toxins [10].

There have been plenty of research on GM food safety which proved physiological alterations in the animals tested but they are not continued. Tests on rats to whose diet a 15% addition of transgenic cucumber was introduced revealed an elevated activity of monocytes and neutrophiles as well as an improvement in fiber digestion and deterioration in protein digestion. The test in which GM potatoes were added to the rat feed showed lowered growth rates, increased small intestine mass, lowered neutrophil count, decreased concentration of zync, iron and nitrogen ions in the liver as well as an increased number of necrotic hepatocytes in the liver in comparison with the control group. A lot of research focuses on examining the ‚history' of the DNA derived from a genetically modified plant in the subsequent links of the food chain. The degree of the DNA transfer from food is believed to be dependent on various factors such as the DNA fragment size, its amount and the alimentary canal structure. However, nowadays it is not widely held that these are functional fragments, capable of protein production [11]. It is worth emphasising that every day we consume foreign DNA from different species, for instance from bacteria found in food. Moreover, potential threats of DNA consumption depend on its sequence, not on the species from which it is obtained [12].

It needs to be emphasised that there have been no differences reported in the nutritious value of GMO products and their conventional counterparts [12].

Unauthorised GM food on the EU market

It is assumed that in the coming years the number of unauthorised GMO products in the European food market may significantly rise. The occurrence of such food can be caused for example by ‚escaping' GM plant from experimentation fields, the accidental occurrence in source material or in market products in Europe of GMOs authorised in other countries outside the European Union [13]. There have been instances reported when GMOs allowed in feed or for other purposes but for consumption were found in food. Also, it is possible that mistakes may occur in grain production control [14].

The list of unathorised genetically modified foods on the Polish market

The occurrences of unauthorised GM food in the European Union are monitored by the RASFF (Rapid Alert System for Food and Feed) and published in the Internet data bases. The RASFF includes all EU countries as well as Norway, Iceland and Lichtenstein. It was established in 2002 by the Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January. It enables fast information exchange between the countries concerning health hazards from food and feed and the prevention measures [15]. The selected occurrences of unauthorised GM food of the Polish market in recent years are presented in Table 2.

Table 2: The list of unathorised genetically modified foods in Poland [4,16].

No	Date of information	Genetically modified ingredient	GMO country of origin
1	13.04.2011	LL601 Rice	Vietnam
2	06.08.2010	Linseed	Canada
3	17.02.2010	FP967 linseed	Canada
4	21.11.2006	35S/bar long grain rice	USA
5	09.11.2006	35S/bar long grain rice	USA
6	16.12.2005	Sweet potato	USA

The potential GMO sources on the Polish market

The genetically modified plant taking the greatest cultivated area in the world is soy [6]. There are many products based on soy on the Polish market such as soy patés, tofu, soy drinks, designed mainly for those who do not consume meat (the first two products) or milk (the soy, milk). There are much more products in which soy is only an additive, such as: ready-to-cook foods, cold meats, biscuits, bread, chocolate. Soy proteins in their different forms (flours, cuts, isolates, concentrates, textured protein) are added to food due to their functional values, which include, among other things, emulgation, stabilization, gelling, water and fat absorption. Soy proteins for instance in the form of isolates are added to meat products in order to stabilize them, bind water and fat, improve its texture. Adding soy proteins in the process of dough production helps to emulgate fat and other ingredients, which makes it less sticky, smoother and kneadable, its shelf life is longer, and the structure and appearance are made better. Addition of skimmed soy flour to bakery products, among other things, improves the structure of the crumb and the colour of the surface, as well as lengthens the freshness of the product. Soy proteins are used for various sauces, soups, giving them desirable thickness and preventing separation of ingredients [17]. Another soy-derived product is soy lecithin, a food additive with emulgation and antioxidant properties, also used as a carrier. It is commonly added to, among the others: chocolates, cocoa, powdered milk, vegetable oils, animal fats, solid oils, bread, biscuits, and grain products such as cereal. Another product obtained from soy is soy oil.

GM rapeseed is used to obtain oil. Rapeseed oil is the third most frequently consumed oil in the world. However, oil has no or very little, insignificant contents of protein and DNA [10]. There are plenty of rapeseed oils on the market designed for cooking, frying and as margarine. It can also be used when making other products such as sweets, savoury snacks, ready-to-cook foods.

The products made with the use of GM beetroot are: refined sugar and molasses. The sugar is highly refined and contains no protein or DNA coming from a plant, but sucrose only.

GM maize is used to produce such products as: oil, flour, starch, fructose syrups. GM cotton is also used to produce oil [10].

Products containing GMOs in Poland

Until 2009, the photos of the labels of products which contained GMOs among their source materials could be found on the Internet (Table 3). Additionally, the website of the International Coalition for Protection of the Polish Country (Międzynarodowa Koalicja dla Ochrony Polskiej Wsi) published a list of such products. Yet, the analysis of the websites after 2009 showed no information about the GMOs content in the products available on the market. This meant that: there was no food produced with such ingredients, the producers did not place a specific ingredient on the list of source materials or they did not know that they produced food from ingredients derived from genetic modification.

All products contained ingredients derived from GM soy. Twelve of them were vegetable oils. There was also one chocolate on the list which contained soy lecithin produced from genetically modified soy.

Table 3: The list of unathorised genetically modified foods in Poland [4, 18].

No	Product	Producer/Importer	Country of origin	Genetically modified ingredient
1	Chocolate	Tiger Consumer Brands Limited	South Africa	Lecithin produced from GM soy
2	Vegetable oil	FHPU Marlibo Z.P. Chr. Czekaj Jacek	No data	Oil from the GM soy seeds
3	Golden oil: universal oil	ZPHU INEX S.J K. Stuglik	No data	Oil from the GM soy seeds
4	Country vegetable oil	PPHU "Olmaj"	No data	Oil from the GM plant seeds
5	Universal vegetable oil	W.Z.T. ADM SZAMOTUŁY	No data	Oil from the GM soy seeds
6	Karolina oil	TK TRADE Sp. z o.o.	No data	Oil from the GM soy seeds
7	Lando oil	Brokelman + Co Oelmuhle GmbH + Co	Germany	Oil from the GM soy seeds
8	Joker vegetable oil	TK TRADE Sp. z o.o.	No data	Oil from the GM soy seeds
9	Common oil	TK TRADE Sp. z o.o.	No data	Oil from the GM soy seeds
10	Vegetable oil	TK TRADE Sp. z o.o.	No data	Oil from the GM soy seeds
11	Perła vegetable oil	TK TRADE Sp. z o.o.	No data	Oil from the GM soy seeds
12	Oilio salad vegetable oil	Leader Price Polska Sp. z o.o.	Belgium	Oil from the GM soy seeds
13	Golden vegetable oil	TK TRADE Sp. z o.o.	No data	Oil from the GM soy seeds

Products containing GMOs in Poland after 2009

In 2014/2015, in Warsaw, in two large hypermarkets: Carrefour Market and E. Leclerc, a market research was carried out involving the analysis of product labels with reference to GMO contents. The researched products included foods which can potentially contain a GMO additive. The products were divided into a few categories: soy products, grain snacks and bars, cereals, packaged biscuits, chocolates, oils, margarines, ready-to-cook products and cold meats (the more detailed data are contained in Dębowska [4]).

The analysis failed to reveal GMO contents in the products. Yet, the result does not make it certain that such products are not available on the Polish market. However, they are not common, which can be a result of consumers' reluctance towards GMOs.

According to the CBOS research conducted in 2012, 28% of those surveyed declared that they had seen genetically modified products on the market; further on, the authors did not make it clear saying that ,it is difficult to state without a doubt if they [consumers] are aware what products really contain GMOs.' 72% of the respondents would not buy a GM food product even if it was much cheaper than the conventional one. Most negative concerns about GM food focused on its adverse effect on health and its interference with the natural environment [19].

The negative attitude of the general public in Poland to GM food makes producers, aware of these preferences, opt for conventional source materials since GM food are not in demand. Therefore, such food is not common in Poland or information about it is not revealed by the producers.

Conclusions

The analysis of GMO contents in the food available on the Polish market in selected shops and the Internet leads to the following conclusions:

1. Until 2009, at least thirteen products containing ingredients derived from GM soy were available on the Polish market. In twelve instances it was soy oil, while one product contained lecithin produced from GM soy.
2. The analysis of the information provided by the producers on the labels of individual products available on the Polish market in 2014/2015 reveals the absence of genetically modified organisms although in Europe products contaning GM soy, rapeseed, cotton, sugar beet and maize were allowed.
3. As the results of the market analysis and consumer survey conducted in 2013 by CBOS Public Opinion Research Centre show, the general public in Poland has a negtive attitude to GMOs. Probably the fear of their unsafety directly results in the lack of common availability of GM food on the food market.
4. The most important factor in GM food is its safety and potential negative impact on human health in future. That is why it is important that constant research is conducted so as to eliminate possible adverse effects of consuming such products.
5. Worldwide, the common use of GMOs in food, feed and other branches of industry makes it possible that they may be found in products other than the intended ones. Therefeore, it is crucial to monitor unauthorised GM food and not to allow it on the market. In the European Union the responsible agency is the RASFF (Food and Feed Safety Alerts).

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